SD11
A5 AR4
87-17

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE RO

REPLY TO: 3420

DATE: September 21, 1987

SUBJECT: Evaluation of Pest Conditions around Jenks Lake, San Gorgonio Ranger District

TO: Forest Supervisor, San Bernardino National Forest

Enclosed is a biological evaluation of pest conditions in the Jenks Lake Recreation Area done by Forest Pest Management. The most significant impact to the vegetation is the compaction and lack of regeneration because of recreation useage in the beach/picnic area. A large, active annosus root disease center is present on the north side of the lake. Several small pockets of western dwarf mistletoe are scattered on the north side of the lake also. Maps of these disease locations were previously sent to Forest personnel.

Several management options are provided for the several forest pests present. Additional information is provided for use in determining what actions are appropriate to deal with the soil compaction situation. A soil scientist or hydrologist would be a better source of information on how to remedy this problem, however.

If you have any questions on this evaluation or need additional assistance, please contact Gregg DeNitto at (415) 556-6940.

JOHN NEISESS
FPM Group Leader
State and Private Forestry

PSW FOREST AND RANGE EXPERIMENT STATION
1987
STATION LIBRARY COPY

FOREST PEST MANAGEMENT
Pacific Southwest Region

Report No. 87-17

3420 Biological Evaluation
Septemebr 21, 1987

EVALUATION OF PEST CONDITIONS AROUND JENKS LAKE, SAN GORGONIO RANGER DISTRICT, SAN BERNARDINO NATIONAL FOREST

Gregg DeNitto, Plant Pathologist
John Pronos, Plant Pathologist
John Dale, Entomologist

ABSTRACT

Jenks Lake is a day-use area designed for picnicking, fishing, and swimming. Present vegetation is a mixed conifer stand with ponderosa and Jeffrey pine in the upper canopy layer and white fir, sugar pine, black oak, and incense-cedar in the lower layers. Openings in the conifer canopy are occupied by large black oaks. A number of annosus root disease pockets were found, but only one, on the northeast end of the lake, appeared to be currently active. A limited amount of western dwarf mistletoe was observed in the yellow pines on the north side of the lake. Three species of true mistletoe were seen in incense-cedar, black oak, and white fir. Two human-caused situations were also affecting vegetation health. The beach and picnic area has been significantly compacted by recreationists, with little duff layer remaining and no regeneration occurring. Trees along the lake have exposed roots from the fluctuating lake level and some are declining.

INTRODUCTION

On June 8 and 10, 1987, we met with John Palermo, Recreation Officer, San Gorgonio RD, and Heber Williams, Landscape Architect, San Bernardino NF, to evaluate the area around Jenks Lake for pest conditions. This is a day-use area designed for fishing, swimming, and picnicking. On the north side of the lake is a beach, picnic area, and interpretive trail. At the east end is a picnic and boating area developed for use by occupants of nearby special use campgrounds.

A vegetation management plan is being developed for the recreation complex. Several problems have already been noted by the District. These include soil compaction in the beach/picnic area, the impact of the fluctuating lake level, the presence of annosus root disease, and poor overall vegetation health. The Forest identified several objectives and needs for our evaluation. These were:

1) to determine the effect of soil compaction on the vegetation and any regeneration attempts in the picnic/beach area;
2) to determine the degree of the impact of the fluctuation of the lake level on shoreline trees;
3) to identify the location of annosus root disease centers;
4) to identify other disease and insect situations;
5) to evaluate the general health of the trees along the lake;
6) to estimate the effects of a new trail on vegetation on the south side of the lake;
7) to provide timber stand improvement needs;
8) and, to provide treatments to reduce disease and insect spread and enhance stand vigor.

OBSERVATIONS

Mixed conifer stands of varying density surround the lake. Species include ponderosa pine, Jeffrey pine, white fir, sugar pine, black oak, and incense-cedar. Most of the ponderosa and Jeffrey pines are mature overstory trees, with little regeneration of the species. Some white fir are in the overstory also, but most are in the intermediate and suppressed crown classes. Large black oaks are present as part of the overstory where there are openings in the conifer canopy. White fir, incense-cedar, sugar pine, and black oak make up the understory. An understory does not exist on the north shore in the picnic and beach area.

The organism presently having the most effect on recreational values because of the loss of tree cover is Heterobasidion annosum. Several openings around old stumps were observed on both sides of the lake. Conks of the fungus were seen in these stumps, suggesting past activity. The only center that is currently active (recent tree mortality) is rather large and located at the northeast side of the lake. The center straddles the service road and extends almost to the interpretive trail. Scattered large black oaks are within the boundaries of the center. A 26-inch dbh Jeffrey pine within this center was under attack by Jeffrey pine beetle, Dendroctonus jeffreyi, and was fading.

In addition to H. annosum, several other potential pest organisms were observed. Along the ridge above the interpretive trail and along the service road on the north side of the lake, we saw three small pockets of western dwarf mistletoe, Arceuthobium campylopodum, in the yellow pines. The pockets were quite limited in size and infections were light in individual trees. The infections were in the lower crowns and were likely causing little, if any, effect on the trees.

Three species of true mistletoe were seen in three different hosts. Incense-cedar mistletoe, Phoradendron juniperinum ssp. libocedri, was scattered in the

area, but was having minimal, if any, effect. Oak mistletoe, P. villosum ssp. villosum, was observed on the north side of Jenks Lake. The number and severity of infections increased along the ridge above the interpretive trail. Similarly, white fir mistletoe, P. bolleanum ssp. pauciflorum, was heaviest along the ridge and on the north side of the interpretive trail at the northwest end of the lake. None of the true mistletoes were causing any significant branch or top-killing, but the infections are becoming severe enough in white fir that top-killing can be expected in some trees.

Several other pathogens and insects were observed in low numbers in the area, but were not presently causing damage. White fir needlecast, Lirula abietis-concoloris, was present on some understory white fir on the southeastern end of the lake. Slight to moderate symptoms of ozone injury were seen on the yellow pine foliage. Dense thickets of pole-size white fir on the south side of the lake were being thinned by fir engraver, Scolytus ventralis. This engraver beetle was causing top-killing and tree mortality. Elytroderma needle disease, caused by Elytroderma deformans, was seen on several yellow pines near the inlet stream at the east end of the lake. The primary concern about this disease in this area is to avoid confusing its broom-like symptoms with witches' brooms caused by western dwarf mistletoe.

In addition to organisms, two other decidedly different situations are having adverse impacts on the vegetation. Compaction and trampling from recreational use are inhibiting the regeneration and growth of vegetation in the beach and picnic area on the north side. The lack of vegetative cover is resulting in no pedestrian traffic management and soil erosion. The large, overmature pines occupying the site appear to be declining and canopy cover is sparse. The majority of the trees would be in Dunning's tree classes 4 or 5, which are rated fair to poor risks. These trees are quite susceptible to bark beetle attack.

The other situation is mainly on the south side of the lake below the service road. Between the lake and the road is an overstocked stand of sapling, pole, and small sawtimber-size trees, mainly white fir. As noted above, some of these trees are being attacked by the fir engraver. Many others have small crowns, little growth, and little vigor. Because of the density, they will continue to be susceptible to successful insect attack. Any disturbance around them may accelerate this process.

PEST MANAGEMENT ALTERNATIVES

1. Annosus Root Disease Management

a. Prevention. The most effective control for annosus root disease is prevention. The fungus usually becomes established in pine stands through infection of freshly cut conifer stumps. An application of borax (sodium tetraborate decahydrate, EPA Reg. No. 1624-94) to all conifer stumps immediately after tree felling will prevent most new infections (see FSM 2303.14, R-5 Supp. 164, 9/86).

b. Disease Center Management. Once established in a site, H. annosum cannot be eradicated. In root disease centers, all conifer species are susceptible to infection through root contacts. These centers can be managed to minimize the effects of the disease by manipulating the tree species. In general, hardwoods are not susceptible and should be favored. Several large oaks are already present in the active disease center on the north side. Regeneration of additional oaks in and around that center will provide cover and possibly reduce the rate of spread of the fungus outward.

2. Dwarf Mistletoe Management

Infections are quite limited at present. With no treatment, the parasite will slowly spread and intensify in the pines. Because of the mixed species in the stand, horizontal spread will be limited. However, the uneven-age nature of the stand may result in infections of any understory yellow pines beneath infected overstory.

At this time, it is feasible to attempt eradication of dwarf mistletoe from the Jenks Lake area. Pruning infected branches would be the only action necessary, except for a few suppressed seedlings and saplings that would have to be removed because of bole infections. Careful surveying of pines for dwarf mistletoe infections will be necessary in and around the pockets of infestation. Because of the probability of missed and latent infections, additional treatments will be necessary 3 and 6 years after the first entry.

3. True Mistletoe Management

Reducing further infection by true mistletoe is more difficult than dwarf mistletoe because the former is vectored by birds and can be readily reintroduced into an area after any treatments. Management of true mistletoe is primarily an individual tree effort, therefore. Other than removing heavily infected individuals, there have been no attempts at managing true mistletoe in incense-cedar or white fir. The benefit of this treatment would be the localized reduction of mistletoe seed which might reduce the amount of feeding and vectoring by birds. This might limit new infections in lightly infected and uninfected trees.

Attempts have been made at reducing the amount of true mistletoe in hardwoods. Three types of treatments have been tried. All of these are directed at reducing the amount of infection and its impact in individual trees. The most effective is the pruning of infected branches. Branches should be removed at least 12 inches below the infection. However, removals should occur at a crotch below the infection so as to reduce future problems from decay and hazards.

A second type of treatment involves cutting the mistletoe shoots and applying a registered pesticide (mixture of 2,4-D and dicamba, Super D Weedone) to the cut staubs. This treatment has been shown effective in reducing future growth of shoots, although the mistletoe infection is not killed. This treatment may reduce seed production for 1.5 to 2 years or more.

The third treatment would be simply the removal of mistletoe shoots from branches. New shoots may appear from the infections in 6 to 12 months, thereby limiting the effectiveness of this treatment. By wrapping the infection sites with black plastic after removing the shoots, this length of time may be significantly increased. There is a hazard of heat damage to limbs beneath the plastic, especially those directly exposed to the sun, from this treatment.

VEGETATION MANAGEMENT AND SITE REHABILITATION

Three of the concerns of forest personnel in the development of the vegetation management plan for Jenks Lake are soil compaction, a fluctuating lake level, and timber stand improvement. Each of these are discussed as they relate to effects on vegetation health and methods of alleviating or rectifying the problems.

Soil Compaction

Soil compaction in the beach/picnic area will have a significant impact on the vigor of old-growth pines and on regeneration efforts. The District plans to rehabilitate this area to reduce erosion and improve the condition of the vegetation. Measures being considered include bank stabilization, terracing, and asphalting individual sites. These measures should reduce erosion and the amount of future compaction.

In order to improve soil aeration and moisture penetration for increasing vegetative health and regeneration success, the present levels of soil compaction need to be reduced. Compaction of this type is mainly limited to the surface 4-6 inches of the soil. Drastic measures, such as deep tilling or ripping, are not required. A plowing or tilling of the surface 4-6 inches of soil would be sufficient. Such activity should occur when the soil is dry to avoid puddling and disrupting of soil aggregates. The lightest weight machinery to accomplish the task should be used. Any wheeled vehicles should have large, low pressure tires. Following plowing, access should be limited to avoid new compaction. Treatment of portions of the area each year for several years may be necessary. A thick, coarse mulch spread over the plowed areas will help to disperse any loads and eventually add organic matter to the soil, thereby improving soil properties. Plowing activities should be limited within the drip line of overstory trees because of the potential for damage to rootlets. The depth of plowing in these areas might be limited to 2 inches, unless surface roots are evident.

Fluctuating Lake Level

Shoreline pines in extensive use fishing areas appear to be maintaining adequate vigor. The pines along the shoreline of the beach/picnic area have been gradually declining and spike tops have been removed from some trees. Wave action and fluctuating water levels, along with human use, have resulted in the loss of soil around some trees. The presence of the lake also may restrict development of primary and secondary lateral roots to the beach area. If so, this would magnify the impaact of soil compaction on tree vigor.

Mitigating soil compaction and planning for replacement trees then becomes even more essential and immediate. Reducing the amount and number of fluctuations in the lake level would save some soil loss, but it is doubtful if soil aeration would improve significantly in the heavy-use areas during periods of lower water levels. A soil scientist or hydrologist should be consulted for a more definitive opinion.

Vegetation Management

Aside from manipulating the vegetation to address the problems of annosus root disease and mistletoe, the possibility of maintaining and improving diversity exists along certain portions of the lakeshore--most conspicuously along the south shore in conjunction with a proposed trail development. Thinning the dense thickets of white fir on the steep south shore would increase the vigor of the selected leave trees and reduce the probability of loss of the better trees in preferred locations--managers usually make more acceptable aesthetic selections of leave trees than do fir engravers. Retention of the larger pines would conform to the visual goal for the area. Thinning also would reduce the stress certain to occur in some trees during trail construction. Trees with defects, tops killed by insects, and mistletoe infections have a high priority for removal.

Thinning during autumn might provide the least conflict with recreational use and also would be the best period for creating slash. By the following spring, the slash would not be suitable host material for engraver beetles. The presence of a maintenance road upslope and parallel to the proposed trail also makes it feasible to create wood chips from the slash for onsite use.

Black oaks are scattered around the lake, as well as the parking lot and entrance. Many of these are overtopped or are becoming overtopped. Removal of competing vegetation would benefit these trees and increase their longevity. Black oaks that are not overtopped generally retain better form characteristics and are less likely to develop hazardous limbs. Black oak sprouts at the west end of the lake should be managed to maintain good form.

Work planned for the dam could include selective removal of trees below the dam. Some of the pines and firs appear to be declining and the stand is overstocked. Removal of the more decadent individuals would aid the younger and more vigorous age classes and improve the overall health and vigor of the stand.

IR4
87-17

87-17 duplicate

UNITED STATES DEPARTMENT OF AGRICULTURE FOREST SERVICE RO

REPLY TO: 3420 DATE: September 21, 1987

SUBJECT: Evaluation of Pest Conditions around Jenks Lake, San Gorgonio Ranger District

TO: Forest Supervisor, San Bernardino National Forest

Enclosed is a biological evaluation of pest conditions in the Jenks Lake Recreation Area done by Forest Pest Management. The most significant impact to the vegetation is the compaction and lack of regeneration because of recreation useage in the beach/picnic area. A large, active annosus root disease center is present on the north side of the lake. Several small pockets of western dwarf mistletoe are scattered on the north side of the lake also. Maps of these disease locations were previously sent to Forest personnel.

Several management options are provided for the several forest pests present. Additional information is provided for use in determining what actions are appropriate to deal with the soil compaction situation. A soil scientist or hydrologist would be a better source of information on how to remedy this problem, however.

If you have any questions on this evaluation or need additional assistance, please contact Gregg DeNitto at (415) 556-6940.

JOHN NEISESS
FPM Group Leader
State and Private Forestry

PSW FOREST AND RANGE EXPERIMENT STATION
1987
STATION LIBRARY COPY

FOREST PEST MANAGEMENT
Pacific Southwest Region

Report No. 87-17

3420 Biological Evaluation
Septemebr 21, 1987

EVALUATION OF PEST CONDITIONS AROUND JENKS LAKE, SAN GORGONIO RANGER DISTRICT, SAN BERNARDINO NATIONAL FOREST

Gregg DeNitto, Plant Pathologist
John Pronos, Plant Pathologist
John Dale, Entomologist

ABSTRACT

Jenks Lake is a day-use area designed for picnicking, fishing, and swimming. Present vegetation is a mixed conifer stand with ponderosa and Jeffrey pine in the upper canopy layer and white fir, sugar pine, black oak, and incense-cedar in the lower layers. Openings in the conifer canopy are occupied by large black oaks. A number of annosus root disease pockets were found, but only one, on the northeast end of the lake, appeared to be currently active. A limited amount of western dwarf mistletoe was observed in the yellow pines on the north side of the lake. Three species of true mistletoe were seen in incense-cedar, black oak, and white fir. Two human-caused situations were also affecting vegetation health. The beach and picnic area has been significantly compacted by recreationists, with little duff layer remaining and no regeneration occurring. Trees along the lake have exposed roots from the fluctuating lake level and some are declining.

INTRODUCTION

On June 8 and 10, 1987, we met with John Palermo, Recreation Officer, San Gorgonio RD, and Heber Williams, Landscape Architect, San Bernardino NF, to evaluate the area around Jenks Lake for pest conditions. This is a day-use area designed for fishing, swimming, and picnicking. On the north side of the lake is a beach, picnic area, and interpretive trail. At the east end is a picnic and boating area developed for use by occupants of nearby special use campgrounds.

USDA, FOREST SERVICE, PACIFIC SOUTHWEST REGION
State and Private Forestry, Forest Pest Management
630 Sansome Street, San Francisco, California 94111

A vegetation management plan is being developed for the recreation complex. Several problems have already been noted by the District. These include soil compaction in the beach/picnic area, the impact of the fluctuating lake level, the presence of annosus root disease, and poor overall vegetation health. The Forest identified several objectives and needs for our evaluation. These were:

1) to determine the effect of soil compaction on the vegetation and any regeneration attempts in the picnic/beach area;
2) to determine the degree of the impact of the fluctuation of the lake level on shoreline trees;
3) to identify the location of annosus root disease centers;
4) to identify other disease and insect situations;
5) to evaluate the general health of the trees along the lake;
6) to estimate the effects of a new trail on vegetation on the south side of the lake;
7) to provide timber stand improvement needs;
8) and, to provide treatments to reduce disease and insect spread and enhance stand vigor.

OBSERVATIONS

Mixed conifer stands of varying density surround the lake. Species include ponderosa pine, Jeffrey pine, white fir, sugar pine, black oak, and incense-cedar. Most of the ponderosa and Jeffrey pines are mature overstory trees, with little regeneration of the species. Some white fir are in the overstory also, but most are in the intermediate and suppressed crown classes. Large black oaks are present as part of the overstory where there are openings in the conifer canopy. White fir, incense-cedar, sugar pine, and black oak make up the understory. An understory does not exist on the north shore in the picnic and beach area.

The organism presently having the most effect on recreational values because of the loss of tree cover is Heterobasidion annosum. Several openings around old stumps were observed on both sides of the lake. Conks of the fungus were seen in these stumps, suggesting past activity. The only center that is currently active (recent tree mortality) is rather large and located at the northeast side of the lake. The center straddles the service road and extends almost to the interpretive trail. Scattered large black oaks are within the boundaries of the center. A 26-inch dbh Jeffrey pine within this center was under attack by Jeffrey pine beetle, Dendroctonus jeffreyi, and was fading.

In addition to H. annosum, several other potential pest organisms were observed. Along the ridge above the interpretive trail and along the service road on the north side of the lake, we saw three small pockets of western dwarf mistletoe, Arceuthobium campylopodum, in the yellow pines. The pockets were quite limited in size and infections were light in individual trees. The infections were in the lower crowns and were likely causing little, if any, effect on the trees.

Three species of true mistletoe were seen in three different hosts. Incense-cedar mistletoe, Phoradendron juniperinum ssp. libocedri, was scattered in the

area, but was having minimal, if any, effect. Oak mistletoe, P. villosum ssp. villosum, was observed on the north side of Jenks Lake. The number and severity of infections increased along the ridge above the interpretive trail. Similarly, white fir mistletoe, P. bolleanum ssp. pauciflorum, was heaviest along the ridge and on the north side of the interpretive trail at the northwest end of the lake. None of the true mistletoes were causing any significant branch or top-killing, but the infections are becoming severe enough in white fir that top-killing can be expected in some trees.

Several other pathogens and insects were observed in low numbers in the area, but were not presently causing damage. White fir needlecast, Lirula abietis-concoloris, was present on some understory white fir on the southeastern end of the lake. Slight to moderate symptoms of ozone injury were seen on the yellow pine foliage. Dense thickets of pole-size white fir on the south side of the lake were being thinned by fir engraver, Scolytus ventralis. This engraver beetle was causing top-killing and tree mortality. Elytroderma needle disease, caused by Elytroderma deformans, was seen on several yellow pines near the inlet stream at the east end of the lake. The primary concern about this disease in this area is to avoid confusing its broom-like symptoms with witches' brooms caused by western dwarf mistletoe.

In addition to organisms, two other decidedly different situations are having adverse impacts on the vegetation. Compaction and trampling from recreational use are inhibiting the regeneration and growth of vegetation in the beach and picnic area on the north side. The lack of vegetative cover is resulting in no pedestrian traffic management and soil erosion. The large, overmature pines occupying the site appear to be declining and canopy cover is sparse. The majority of the trees would be in Dunning's tree classes 4 or 5, which are rated fair to poor risks. These trees are quite susceptible to bark beetle attack.

The other situation is mainly on the south side of the lake below the service road. Between the lake and the road is an overstocked stand of sapling, pole, and small sawtimber-size trees, mainly white fir. As noted above, some of these trees are being attacked by the fir engraver. Many others have small crowns, little growth, and little vigor. Because of the density, they will continue to be susceptible to successful insect attack. Any disturbance around them may accelerate this process.

PEST MANAGEMENT ALTERNATIVES

1. Annosus Root Disease Management

a. Prevention. The most effective control for annosus root disease is prevention. The fungus usually becomes established in pine stands through infection of freshly cut conifer stumps. An application of borax (sodium tetraborate decahydrate, EPA Reg. No. 1624-94) to all conifer stumps immediately after tree felling will prevent most new infections (see FSM 2303.14, R-5 Supp. 164, 9/86).

b. Disease Center Management. Once established in a site, H. annosum cannot be eradicated. In root disease centers, all conifer species are susceptible to infection through root contacts. These centers can be managed to minimize the effects of the disease by manipulating the tree species. In general, hardwoods are not susceptible and should be favored. Several large oaks are already present in the active disease center on the north side. Regeneration of additional oaks in and around that center will provide cover and possibly reduce the rate of spread of the fungus outward.

2. Dwarf Mistletoe Management

Infections are quite limited at present. With no treatment, the parasite will slowly spread and intensify in the pines. Because of the mixed species in the stand, horizontal spread will be limited. However, the uneven-age nature of the stand may result in infections of any understory yellow pines beneath infected overstory.

At this time, it is feasible to attempt eradication of dwarf mistletoe from the Jenks Lake area. Pruning infected branches would be the only action necessary, except for a few suppressed seedlings and saplings that would have to be removed because of bole infections. Careful surveying of pines for dwarf mistletoe infections will be necessary in and around the pockets of infestation. Because of the probability of missed and latent infections, additional treatments will be necessary 3 and 6 years after the first entry.

3. True Mistletoe Management

Reducing further infection by true mistletoe is more difficult than dwarf mistletoe because the former is vectored by birds and can be readily reintroduced into an area after any treatments. Management of true mistletoe is primarily an individual tree effort, therefore. Other than removing heavily infected individuals, there have been no attempts at managing true mistletoe in incense-cedar or white fir. The benefit of this treatment would be the localized reduction of mistletoe seed which might reduce the amount of feeding and vectoring by birds. This might limit new infections in lightly infected and uninfected trees.

Attempts have been made at reducing the amount of true mistletoe in hardwoods. Three types of treatments have been tried. All of these are directed at reducing the amount of infection and its impact in individual trees. The most effective is the pruning of infected branches. Branches should be removed at least 12 inches below the infection. However, removals should occur at a crotch below the infection so as to reduce future problems from decay and hazards.

A second type of treatment involves cutting the mistletoe shoots and applying a registered pesticide (mixture of 2,4-D and dicamba, Super D Weedone) to the cut staubs. This treatment has been shown effective in reducing future growth of shoots, although the mistletoe infection is not killed. This treatment may reduce seed production for 1.5 to 2 years or more.

The third treatment would be simply the removal of mistletoe shoots from branches. New shoots may appear from the infections in 6 to 12 months, thereby limiting the effectiveness of this treatment. By wrapping the infection sites with black plastic after removing the shoots, this length of time may be significantly increased. There is a hazard of heat damage to limbs beneath the plastic, especially those directly exposed to the sun, from this treatment.

VEGETATION MANAGEMENT AND SITE REHABILITATION

Three of the concerns of forest personnel in the development of the vegetation management plan for Jenks Lake are soil compaction, a fluctuating lake level, and timber stand improvement. Each of these are discussed as they relate to effects on vegetation health and methods of alleviating or rectifying the problems.

Soil Compaction

Soil compaction in the beach/picnic area will have a significant impact on the vigor of old-growth pines and on regeneration efforts. The District plans to rehabilitate this area to reduce erosion and improve the condition of the vegetation. Measures being considered include bank stabilization, terracing, and asphalting individual sites. These measures should reduce erosion and the amount of future compaction.

In order to improve soil aeration and moisture penetration for increasing vegetative health and regeneration success, the present levels of soil compaction need to be reduced. Compaction of this type is mainly limited to the surface 4-6 inches of the soil. Drastic measures, such as deep tilling or ripping, are not required. A plowing or tilling of the surface 4-6 inches of soil would be sufficient. Such activity should occur when the soil is dry to avoid puddling and disrupting of soil aggregates. The lightest weight machinery to accomplish the task should be used. Any wheeled vehicles should have large, low pressure tires. Following plowing, access should be limited to avoid new compaction. Treatment of portions of the area each year for several years may be necessary. A thick, coarse mulch spread over the plowed areas will help to disperse any loads and eventually add organic matter to the soil, thereby improving soil properties. Plowing activities should be limited within the drip line of overstory trees because of the potential for damage to rootlets. The depth of plowing in these areas might be limited to 2 inches, unless surface roots are evident.

Fluctuating Lake Level

Shoreline pines in extensive use fishing areas appear to be maintaining adequate vigor. The pines along the shoreline of the beach/picnic area have been gradually declining and spike tops have been removed from some trees. Wave action and fluctuating water levels, along with human use, have resulted in the loss of soil around some trees. The presence of the lake also may restrict development of primary and secondary lateral roots to the beach area. If so, this would magnify the impaact of soil compaction on tree vigor.

Mitigating soil compaction and planning for replacement trees then becomes even more essential and immediate. Reducing the amount and number of fluctuations in the lake level would save some soil loss, but it is doubtful if soil aeration would improve significantly in the heavy-use areas during periods of lower water levels. A soil scientist or hydrologist should be consulted for a more definitive opinion.

Vegetation Management

Aside from manipulating the vegetation to address the problems of annosus root disease and mistletoe, the possibility of maintaining and improving diversity exists along certain portions of the lakeshore--most conspicuously along the south shore in conjunction with a proposed trail development. Thinning the dense thickets of white fir on the steep south shore would increase the vigor of the selected leave trees and reduce the probability of loss of the better trees in preferred locations--managers usually make more acceptable aesthetic selections of leave trees than do fir engravers. Retention of the larger pines would conform to the visual goal for the area. Thinning also would reduce the stress certain to occur in some trees during trail construction. Trees with defects, tops killed by insects, and mistletoe infections have a high priority for removal.

Thinning during autumn might provide the least conflict with recreational use and also would be the best period for creating slash. By the following spring, the slash would not be suitable host material for engraver beetles. The presence of a maintenance road upslope and parallel to the proposed trail also makes it feasible to create wood chips from the slash for onsite use.

Black oaks are scattered around the lake, as well as the parking lot and entrance. Many of these are overtopped or are becoming overtopped. Removal of competing vegetation would benefit these trees and increase their longevity. Black oaks that are not overtopped generally retain better form characteristics and are less likely to develop hazardous limbs. Black oak sprouts at the west end of the lake should be managed to maintain good form.

Work planned for the dam could include selective removal of trees below the dam. Some of the pines and firs appear to be declining and the stand is overstocked. Removal of the more decadent individuals would aid the younger and more vigorous age classes and improve the overall health and vigor of the stand.